

Exhibit 4

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

ORACLE AMERICA, INC.,)	
)	
Plaintiff,)	
)	
v.)	Civ. A. No. 10-03561 WHA
)	
GOOGLE INC.,)	(Jury)
)	
Defendant.)	

SUPPLEMENTAL EXPERT REPORT OF PROFESSOR ADAM JAFFE, Ph.D.

March 28, 2016

CONFIDENTIAL – ATTORNEYS’ EYES ONLY
PURSUANT TO PROTECTIVE ORDER

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed on this 28th day of March, 2016, in New York, New York.

A handwritten signature in black ink, appearing to read "Adam Jaffe", written over a horizontal line.

Adam Jaffe, PhD

I. ASSIGNMENT

1. I was retained by plaintiff Oracle America, Inc. (“Oracle”) to undertake an analysis of the economic issues surrounding whether Google Inc.’s (“Google”) use of Oracle’s copyrighted works constitutes a “fair use.” On February 8, 2016, I submitted a report of my economic analysis of (1) the purpose and character of Google’s use of Oracle’s copyrighted works, (2) the effect of Google’s use upon the potential market for or value of the Java platform, and (3) certain economic assertions in Dr. Owen Astrachan’s January 8, 2016 report.¹

2. On February 8, 2016, Google’s damages expert Dr. Gregory Leonard submitted a rebuttal report on damages.² I responded to certain claims in Dr. Leonard’s report which are fundamentally economic in nature in my report dated February 29, 2016.³

3. On March 18, 2016, the Court-appointed damages expert, Professor James Kearl, submitted a report evaluating the damages analyses of Oracle’s and Google’s damages experts.⁴ Professor Kearl is an economist, and portions of his report relate to economic issues, including economic issues I have discussed in my earlier reports. I have been asked to respond to certain economic topics in Professor Kearl’s report, including his use of the non-infringing alternative construct in apportioning disgorgement damages and the use of Dr. Leonard’s market share model.

4. The opinions and information contained in this report are based on my knowledge and understanding of the currently available record. However, my study is ongoing. Accordingly, I may revise or supplement my expert opinions to reflect any additional analyses I may formulate based upon additional testimony, newly acquired information, court determinations on evidence that will be excluded at trial, or views expressed by the parties’ expert witnesses. I also expect to create trial demonstratives including graphical depictions and presentations of my opinions.

5. A list of the materials I have considered or relied upon in the course of preparing this report is in Appendix B.

¹ See generally, Expert Report of Professor Adam Jaffe, Feb. 8, 2016.

² See generally, Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

³ See generally, Expert Rebuttal Report of Professor Adam Jaffe, Feb. 29, 2016.

⁴ See generally, Expert Report of Professor James Kearl, Mar. 18, 2016.

II. QUALIFICATIONS

6. A full description of my qualifications is found in my February 8, 2016 report, and my full curriculum vitae is attached to this report as Appendix A.

7. I am being compensated in this matter at my standard rate of \$1,200 per hour. This compensation is not contingent in any way upon my testimony or upon the result of this proceeding.

III. SUMMARY OF OPINIONS

8. In this report, I briefly discuss two important areas in which Professor Kearn's economic analysis is in my view incorrect given the context.⁵

9. There are a number of sound economic reasons why the copyright remedy defined in the Copyright Act as “disgorgement of profits” should not be calculated relative to a non-infringing alternative. I understand that disgorgement damages provide a means of deterring would-be infringers from copying. Use of non-infringing alternatives in a disgorgement analysis creates *ex ante* economic incentives such that the expected value of infringing is higher than the expected value of respecting the owner's copyright(s). In other words, invoking a non-infringing alternative analysis in the context of copyright infringement disgorgement of profits creates a situation in which the would-be infringer's rational economic decision is to copy without permission.⁶ This perverse incentive is at odds with the purpose of copyright remedies, which I understand are

⁵ I have been asked to focus on and comment on specific economic assertions in Professor Kearn's report. However, it is worth noting that I agree with a number of Professor Kearn's arguments. First, regarding OpenJDK, I wholly agree with Professor Kearn's statement that it is surprising that Google chose to copy and continue to use Oracle's Java APIs without a license for many years, if using OpenJDK for less than \$100,000 in transition costs was actually a viable option when Android was being developed. Second, regarding Google's but-for costs, I agree that Dr. Leonard's estimates of developer training costs are unreasonably low because they do not consider that *ex ante*, the applications which will become hits are unknown. Similarly, Dr. Leonard's estimate of Google's costs to internally develop a set of hit applications suffers from the same error. Additionally, with respect to both of these but-for cost calculations, Dr. Leonard's analysis assumes without support that only “top” applications matter to an emerging platform. This is inconsistent with my understanding of early stage platform businesses and platform economics. (Expert Report of Professor James Kearn, Mar. 18, 2016, p 27-29.)

⁶ It is worth noting that Google's damages expert Dr. Leonard has co-authored a paper on this subject. *See*, Hausman, Jerry A., Gregory K. Leonard, and Gregory Sidak. “Patent Damages and Real Options: How Judicial Characterization of Noninfringing Alternatives Reduces Incentives to Innovate.” *Berkeley Technology Law Journal* 22.2 (2007): 825-853, at 826-27 (“By ‘free option,’ we mean that a firm may keep its options open by using potentially infringing technology rather than technology that definitely does not infringe.”).

intended to discourage unlawful copying. Further, in the case of a combined offering made up of material from both the copyright owner and the infringer, the infringer (and not the copyright holder) will necessarily capture the synergies from the combination of the infringer's work with that of the copyright holder. If one purpose of copyright "disgorgement of profits" is to ensure that the infringer retains no benefit from the infringement, then the consideration of non-infringing alternatives would make it difficult or impossible, economically speaking, to achieve that goal.

10. Footnote 8 in Professor Kearl's report uses a quotation from my earlier report to suggest that I agree with his position that disgorgement of profits should be calculated relative to a non-infringing alternative. The limited quotation he uses is taken out of context, and it is clear from the original context that my use of the word "alternatives" there is with reference to a completely different question—the viability of Google using OpenJDK in the mid-2000s—and does not support or even suggest that non-infringing alternatives have a role to play in calculating disgorgement of profits.

11. My first and second reports included extensive analyses of platform economic concepts and the critical role they play in this case. The mobile market is a dynamic platform market, and the success of competitors depends on factors such as early entry, tipping points, expectations, and network effects. Google's copying of the Java API packages occurred at a time of great uncertainty in the mobile phone competition landscape. The Java API packages enabled early entry into the smartphone market and access to the developer, OEM and carrier communities, which were critical to Android's success. Professor Kearl's review and corrections to Dr. Leonard's market share analysis still use a quantitative model of customer decision-making that explicitly excludes any consideration of the effect of apps availability on the very presence of different models in the market, and is explicitly derived from and based on the mobile phone market in a time period *after* Android had avoided typical and predicted platform failure. The continued reliance on economic models that simply *assume* Android's achievement of minimal viable success fails to recognize the importance of fundamental platform economic concepts. By failing to consider even the possibility of marketplace failure of a delayed Android with untested and unknown APIs, any such analysis necessarily understates the value the Java APIs provided in allowing Android to establish itself as a viable platform competitor.

IV. PROFESSOR KEARL'S APPLICATION OF NON-INFRINGEMENT ALTERNATIVES

12. Professor Kearl considers non-infringing alternatives to assess the parties' respective damages analyses. Non-infringing alternatives are potential replacements for the work. Professor Kearl explains his view on the use of non-infringing alternatives for a disgorgement analysis in several places throughout his report:

- Consideration of non-infringing alternatives in a disgorgement analysis makes economic sense, either explicitly or as a basis for apportionment.⁷
- [T]here does not appear to be a clear distinction between considering non-infringing alternatives and apportioning wrongful profits based on relative value of the copyrighted material to the overall work.⁸
- [A]s an economist it seems sensible to allow (indeed, to require) consideration of the next best non-infringing alternative.⁹

I find that, in the case of each aspect of copyright damages disgorgement remedy, the inclusion of a non-infringing alternative analysis creates a perverse economic incentive that is not aligned with the role of disgorgement in statutory copyright damages.

A. Lost Profits and Disgorgement

13. I understand that the copyright damages estimates presented in this case have two primary components, lost profits (actual damages) and disgorgement of infringer's profits.¹⁰ The Copyright Act allows the copyright holder to recover both lost profits and infringer's profits, excluding any overlap between the two:

The copyright owner is entitled to recover the actual damages suffered by him or her as a result of the infringement, and any profits of the infringer that are attributable to the infringement and are not

⁷ Expert Report of Professor James Kearl, Mar. 18, 2016, p. 6.

⁸ Expert Report of Professor James Kearl, Mar. 18, 2016, p. 7.

⁹ Expert Report of Professor James Kearl, Mar. 18, 2016, p. 19.

¹⁰ I understand there is a third category of copyright damages, statutory damages, which are not discussed in Drs. Kearl and Leonard's reports.

taken into account in computing the actual damages. In establishing the infringer's profits, the copyright owner is required to present proof only of the infringer's gross revenue, and the infringer is required to prove his or her deductible expenses and the elements of profit attributable to factors other than the copyrighted work.¹¹

14. Lost profits can be calculated as the lost sales (converted to profits), lower prices (often called "price erosion"), or increased costs to the plaintiff caused by the infringement.¹² Lost profits can also include lost license fees and a constructive license analysis can be conducted to measure these lost license fees.¹³ Under any of these measures, lost profits can be less than the gain to the infringer. In such situations, it could be economically rational to infringe, because the infringer would earn more profit than it would eventually pay in lost profits to the plaintiff.¹⁴ Thus, if the goal of the statute is to deter copyright infringement then lost profits alone may not be sufficient to achieve that purpose. For example, if the plaintiff is a less efficient producer than the defendant, then the incremental profit per unit will be higher for the defendant than the plaintiff. In a two-party market, if the plaintiff recovers all of its lost profits, that number will still be smaller than the infringer's total gain. Copyright disgorgement requires the defendant to surrender all of its gain—including the incremental amount it received because of its status as a more efficient producer.¹⁵

¹¹ 17 U.S.C. § 504(b).

¹² Glick, Mark A., Lara A. Reymann, and Richard Hoffman. *Intellectual property damages: guidelines and analysis*. John Wiley & Sons, (2002), p. 317.

¹³ See, e.g., *Oracle Corp. v. SAP AG*, 765 F.3d 1081 (9th Cir. 2014); *Polar Bear Productions, Inc. v. Timex Corp.*, 384 F.3d 700 (2004); see also, Glick, Mark A., Lara A. Reymann, and Richard Hoffman. *Intellectual property damages: guidelines and analysis*. John Wiley & Sons, (2002), p. 317.

¹⁴ Glick, Mark A., Lara A. Reymann, and Richard Hoffman. *Intellectual property damages: guidelines and analysis*. John Wiley & Sons, (2002), p. 322.

¹⁵ See, e.g., *Taylor v. Meirick*, 712 F. 2d 1112, 1120 (7th Cir. 1983) (Posner, J.) ("It is true that if the infringer makes greater profits than the copyright owner lost, because the infringer is a more efficient producer than the owner or sells in a different market, the owner is allowed to capture the additional profit even though it does not represent a loss to him. It may seem wrong to penalize the infringer for his superior efficiency and give the owner a windfall. But it discourages infringement. By preventing infringers from obtaining any net profit it makes any would-be infringer negotiate directly with the owner of a copyright that he wants to use, rather than bypass the market by stealing the copyright and forcing the owner to seek compensation from the courts for his loss. Since the infringer's gain might exceed the owner's loss, especially as loss is measured by a court, limiting damages to that loss would not effectively deter this kind of forced exchange. This analysis also implies that some of the 'windfall' may actually be profit that the owner would have obtained from licensing his copyright to the infringer had the infringer sought a license."); see also, *Bucklew v. Hawkins, Ash, Baptie & Co.*, 329 F.3d 923, 931 (7th Cir. 2003) (Posner, J.) ("Copyright infringement[,] unlike patent infringement[,] is an intentional tort, and by forcing the infringer to disgorge his profit should it exceed the copyright owner's loss[,] the law discourages infringement and encourages the would-be infringer to transact with the copyright owner rather than 'steal' the copyrighted work.").

15. Because of this, the lost profits component of copyright damages on its own is not a complete economic deterrent to unlawful copying.

B. Expected Value of Disgorgement of Profits

16. I understand that the rules for calculating disgorgement of infringer's profits in a copyright case are different from the rules for calculating lost profits.¹⁶ As a result, disgorgement puts in place an economic deterrent:

The clear purpose of this [infringer's profits] statutory scheme is to prevent the infringer from unfairly benefiting from a wrongful act. In other words, the Copyright Act aims to remove the incentives for an "efficient breach," for example, an unauthorized act that is economically rational in that the infringer has the ability to profit more from the illegal act than the copyright owner does from the legal exercise of his or her rights. Absent the possibility of recovering the infringer's profits, the infringer could rationalize that the unauthorized use of the copyrighted work would be on net profitable.¹⁷

In order for disgorgement copyright damages to create an economic deterrent, the would-be infringer must expect a worse outcome (value) if he or she chooses to infringe. Put differently, when the expected value of infringing is lower than the expected value of not infringing, a rational actor will choose not to infringe.¹⁸

17. The approach to calculating infringer's profits can alter this economic incentive. In particular, if the methodology reduces the amount of disgorgement of profits such that the remedy does not place the would-be infringer in a worse-off position, disgorgement of profits ceases to provide an economic deterrent. As I explain below, the use of non-infringing alternatives in a

¹⁶ 17 U.S.C. § 504(b).

¹⁷Glick, Mark A., Lara A. Reymann, and Richard Hoffman. *Intellectual property damages: guidelines and analysis*. John Wiley & Sons, (2002), p. 322.

¹⁸ In economics, "expected value" is an expression that explains probability-weighted average outcome of a given decision. It is calculated as the likelihood of each potential outcome times the value of each potential outcome. For example, suppose I participate in a game where the host flips a coin and promises me \$10 if the coin is heads and \$0 dollars if the coin is tails. Assuming a fair coin (50% probability of both heads and tails) my expected value from playing the game is \$5 ($[50\% \times \$10] + [50\% \times \$0]$).

disgorgement calculation has the same effect, it eliminates the economic deterrent for engaging in copyright infringement.

18. If infringer's profits are reduced because of the availability of a non-infringing alternative—that is, if they are limited to the *difference* between the gained profits from copying and the gained profits from a non-infringing alternative, there will never be a disincentive to infringement. This is also true if the apportionment of infringer's profits is limited to the "value" of a non-infringing alternative. This is because a prospective infringer is effectively faced with two options: (1) Choose a non-infringing alternative and generate \$X in value; or (2) copy, generate even more profits \$Y, and risk an adverse judgment.¹⁹ An economically rational actor who seeks to maximize his profit would always choose the second option if he can earn greater profits by infringement than he does from using a non-infringing alternative.

19. If non-infringing alternatives are allowed as part of the disgorgement or apportionment calculus and the prospective infringer chooses to copy and is found liable, he will only pay an amount equal to infringing profits minus the value of the next best alternative (i.e., non-infringing alternative $\text{Infringer's Profits} = \$Y - \$X$). After paying profits, the infringer is still left with the value of the next-best alternative, or \$X.²⁰ This means that in both cases—both the “before” case when considering whether to do the right thing and obtain a license, and the “after” case of non-infringing alternative-influenced disgorgement—the infringer makes a profit of \$X. Since there is some chance that the infringer will get away with copying and retain \$Y profits, there is upside to risking infringement, and no downside. Either way, the prospective infringer generates profits of at least \$X.²¹

¹⁹ Of course there is a third option, taking a license to the work. For the purposes of this discussion I assume that the would-be infringer has decided against licensing the work, as Google did.

²⁰ Profits retained after paying damages = $\$Y - (\$Y - \$X)$, or \$X.

²¹ Professor Kearl acknowledges that a calculation incorporating non-infringing alternatives can be both under- and over-inclusive. *See*, Deposition of Professor James Kearl, Mar. 23, 2016, pg. 189:22-190:21. (“Question: When using non-infringing alternatives to calculate value, is it possible that, based on cost savings alone, even in the absence of profit there would be disgorgement? Answer: I suppose so, yes, that is if -- if -- because a -- an entity took something, it was then able to reduce its losses from what they would otherwise be, then I suppose -- I don't know what the law is, but I suppose you could think of the reduction of losses as -- as a gain to the firm and, therefore, subject to disgorgement. Question: And is it true that if you calculate value using a non-infringing alternative that results in, you know, zero costs to switch, as it were, then the defendant -- the defendant disgorges nothing, even if they earned profits in the meantime during the period of use of the intellectual property. Answer:

20. Another way of looking at this is by considering the *ex-ante* effect of a potential license. If the disgorgement rule is designed to deter infringement—and therefore promote seeking a license—then the disgorgement should make the infringer worse off than he would have been had he taken the license. If the copyright owner were willing to grant a license for anything less than 100% of the profits expected to be generated by inclusion of the copyrighted material, then the infringer is better off by taking the license rather than risking suit and disgorgement. Put another way, the statute acts as an incentive to bargaining and a reduction of litigation only when the infringer is at risk of losing all profits associated with the infringement.

C. Synergies between copyrighted work and potential infringer contributions

21. In addition to producing a scenario under which disgorgement creates no incentive for non-infringement, using non-infringing alternatives in a copyright disgorgement calculation arbitrarily awards to the infringer all value flowing from any synergies generated by the combination of the copyrighted work with other additions. This is because it is very difficult, if not impossible, for consideration of non-infringing alternatives to allocate such synergies. There are no reliable and well-accepted economic methods of which I am aware that can account for and properly allocate such synergies in constructing hypothetical valuations using non-infringing alternatives.

22. For example, imagine there are two necessary elements for platform success—J (the copyrighted work) and A (the contribution of infringer). If there are synergies between J and A, this means that the value of the combination exceeds the sum of the value of J and the value of A. Imagine further that the infringer need only compensate the copyright holder for the value of her work, as compared to the next best alternative. The effect of this is that the infringer retains both the value of its contribution *and* also all of the synergistic value. In a well-functioning market for intellectual property, A would have to pay J for J's contribution, and also share some of the value created by synergies. The parties would ordinarily be expected to bargain for a sharing of such surplus. A disgorgement remedy based only on incremental infringer's profit relative to the next best alternative does not achieve this outcome.

Yes. But the -- but the hypothetical that you just gave me, the but-for you just gave me is a but-for in which what you took wasn't worth anything. So the profits you got were profits that weren't attributable to what you took.”).

23. In his deposition, Professor Kearn indicated that he agrees that the uncertainty arises when using non-infringing alternatives to attempt to attribute synergies that result from a combination of products:

Question: Is it true that the use of non-infringing alternatives allows the infringer to retain the value of the synergies, under those circumstances?

Answer: That's a -- an interesting question. The -- the fundamental problem is that if you have synergies, they're attributed to the jointness and, therefore, you can't parcel out the contribution of any single thing to the synergy, at least not easily. The -- and to the degree that a counterfactual -- claim to do that, then it would -- you know, then -- then it would be claiming too much.²²

Further, Professor Kearn acknowledges that the Berry-Kim model used by Dr. Leonard does not attempt to allocate the synergies:

Question: Is there anything about Dr. Leonard's use of the Kim model that attempts to account for and allocate synergies as between the input Java and the rest of the -- the Android platform?

Answer: No.²³

24. Similarly, the use of the next-best alternative construct does not provide a means to properly apportion the synergies between the copyrighted work and the contribution of the infringer. The next-best alternative, in fact, might suggest that mixed synergies (those that result from the combination) be awarded to the infringer. In addition to undermining the purposes of disgorgement, this would create a wholly speculative allocation of the synergies because of the difficulty of the problem. I understand that there is some history in the law as it pertains to apportionment in copyright disgorgement requiring the disgorgement of all profits, rather than apportioned profits, where there has been "commingling." As I understand it, commingling occurs when the value contributed by the copyright owner is not readily separated from the value created by the infringer. The difficulty economists have in accounting for synergies provides a sound

²² Deposition of Professor James Kearn, Mar. 23, 2016, p. 206:17-207:5.

²³ Deposition of Professor James Kearn, Mar. 23, 2016, p. 207:12-18.

economic basis for application of this legal rule, if the purpose of the rule is to deter infringement and thereby incentivize bargaining.

D. Footnote 8

25. Professor Kearn references my February 8, 2016 report in his discussion of using non-infringing alternatives as the basis for apportioning infringer's profits:

Oracle's other economic expert, Professor Jaffe, appears to agree with me, as stated in his (corrected) February 8, 2016 report, para. 440: "As an economist, I think about the decisions companies make in light of the alternatives they are considering."²⁴

26. Professor Kearn's reference to my report is out of context and does not substantiate his claim regarding the use of non-infringing alternatives in a copyright disgorgement of profits analysis. For context, I reproduce the paragraph that Professor Kearn is citing from my February 8th report with the quoted text bolded:

The simplest evidence that OpenJDK was not a commercially reasonable option for Google is the fact that Google did not use it. **As an economist, I think about the decisions companies make in light of the alternatives they are considering.** In 2007, when Google made the choice to commercially release Android, OpenJDK had been announced as an available option. Google did not choose to use OpenJDK for Android, which means they viewed the alternative, copying the Java API packages without a license, to be more economically beneficial. As time went on and Google was faced with litigation over its use of the Java API packages, it still chose to not use OpenJDK. ... This again suggests that Google viewed there to be significant costs or potential downsides to using OpenJDK. And that OpenJDK was not a commercially reasonable option for Google.²⁵

The full context of the paragraph above shows I was discussing the fact that, from an economic perspective, an indicator that OpenJDK was not a plausible option for Google is reflected by the fact that Google in fact chose not pursue OpenJDK at the time it developed and launched Android.

²⁴ Expert Report of Professor James Kearn, Mar. 18, 2016, fn. 8.

²⁵ Expert Report of Professor Adam Jaffe, (corrected) Feb. 8, 2016, paragraph 440.

Professor Kearl and I agree on this.²⁶ My discussion of alternatives is thus in the context of evaluating potential choices that a firm had and why they actually made the choices they did.²⁷ This is quite different from the legal construct of whether non-infringing alternatives are relevant in copyright disgorgement on a post-hoc basis. In fact, in my February 29, 2016 report, I state my reservations with respect to Dr. Leonard's use of non-infringing alternatives when calculating copyright damages:

From an economic perspective, whether or not it is necessary to consider alternative or counterfactual scenarios as a baseline depends on the purpose to which the analysis is to be put. I understand from counsel that the relevance of counterfactuals in a disgorgement analysis is a legal question. Therefore, Dr. Leonard's statement that there is an economic requirement to consider a specific counterfactual scenario as the baseline to measure disgorgement damages is unsupported.²⁸

27. As the excerpt from my second report indicates, I do not have an opinion on the legal applicability of non-infringing alternatives. I also note, however, that in the first phase of this case, the use of non-infringing alternatives in calculating copyright disgorgement of profits was deemed inadmissible.²⁹ And to the extent that the copyright law disgorgement of profits remedy reflects a policy of *deterrence*, then as an economist it is my opinion that the use of non-infringing alternatives is inconsistent with that policy goal for the reasons discussed. Thus, the earlier rule employed by the Court would seem to be the correct one from an economic perspective.

²⁶ Expert Report of Professor James Kearl, Mar. 18, 2016, p. 23.

²⁷ Professor Kearl, in his deposition describes this consideration. Deposition of Professor James Kearl, Mar. 23, 2016, p. 162:10-20 ("It [revealed preferences] has a technical meaning in economics, and it is also used in kind of a casual way, and I was using it in the casual way. And the casual way of using it is, people claim lots of things, they say lots of things. But from an economist's perspective, the best evidence is what they choose to do. So if I have a set of options and I choose A, when B was available or C was available, then I have revealed that A is better for me than B or C.").

²⁸ Expert Report of Professor Adam Jaffe, Feb. 29, 2016, p. 9, fn. 12.

²⁹ ECF 632, November 28, 2011. ("Not acceptable, however, is allowing the existence of non-infringing alternatives to reduce recovery of wrongful profits. This is a distinct remedy for the purpose of disgorgement. Non-infringing alternatives have nothing to do with this.").

V. PROFESSOR KEARL'S AND DR. LEONARD'S TREATMENT OF PLATFORM ECONOMICS

28. In my February 8, 2016 report, I discuss platform economics at great length. In particular, I describe the role of important platform economic factors such as early entry, tipping points, expectations, and network effects.³⁰ In my second report, I further describe the very real risks of platform failure and the nonlinear nature of platform competition.³¹ As I describe above, I do not agree that, from an economic perspective, the use of non-infringing alternatives in a disgorgement analysis is appropriate. However, to the extent that one is attempting to model an alternative outcome in a platform market, it is critical that the analysis takes into account the high degree of uncertainty and risk of failure—driven by platform economics—that is present in early stage platform markets. Given this high risk of failure, any analysis of the value of Java's contribution to Android that looks only at the marginal impact on Android *after* it was successfully established ignores a potentially very large benefit—the significant reduction in the risk of marketplace failure that Java brought by speeding introduction and allowing Android to present itself to OEMs, carriers, and app developers as a system with a proven applications interface and security model.³²

29. Android's existential uncertainty absent the copying of the Java API packages is not reflected in any way in Dr. Leonard's market share damages calculations—which simulate changes to market share only after Android has achieved viability and competitive balance with the iPhone. Dr. Leonard's use of the Kim model—an econometric model based largely on post-2010 data that ignores platform economic factors such as tipping points and simply takes as a given the presence of Android phones in the market in 2010—means that Dr. Leonard's calculations cannot possibly

³⁰ Expert Report of Professor Adam Jaffe, Feb. 29, 2016, p. 17-23.

³¹ Expert Report of Professor Adam Jaffe, Feb. 29, 2016, *see, e.g.* p. 15 ("Platform markets are subject to competitive forces that amplify the importance of market entry timing. As I describe in my February 8, 2016 report, platform markets can often only sustain a small number of competitors because of network effects. Once a given platform has reached a critical mass of users, markets can 'tip' which makes entry and success of competing platforms difficult. Google recognized this challenge and was therefore focused on developing a mobile platform presence to avoid getting 'locked out.'").

³² Professor Kearl rightly acknowledges the importance of *ex-ante* analysis in the context of mobile applications. The same is true, of course, with respect to the viability of the Android platform. *See, e.g.* Deposition of Professor James Kearl, Mar. 23, 2016, p. 67:8-22. (Answer: "My criticism of Dr. Leonard is that he focuses on the ex post successful apps, and -- and has not addressed the question about how you got that number of ex post successful apps. And that -- and, therefore, his analysis or methodology is a nifty answer to the wrong question, in some ways. ... But -- but simply looking at the ex post successful apps and looking at the number 10 or the top 20, isn't -- doesn't really deal with the issue about whether or not you needed lots of apps in the race.").

incorporate the risk of Android failing. As I describe in my previous reports, this risk was substantial. Further, as described in my February 29, 2016 report, Dr. Leonard does not explicitly address how he incorporated an analysis of the platform economic factors facing Android as it was attempting to launch, either in his use of the Kim model, or anywhere else in his analysis.³³ While Professor Kearnl makes certain adjustments, as I describe herein, none of these adjustments solves this problem—as he acknowledged at his deposition.

30. Professor Kearnl provides an adjusted version of Dr. Leonard’s market share analysis. However, Professor Kearnl’s adjustments are directed at specific assumptions that are inputs to the Kim model. Professor Kearnl does not discuss the applicability of the Kim model itself, or Dr. Leonard’s implicit assumption that even under significantly different conditions, Android would have been in approximately the same competitive position as the one it achieved launching with the Java APIs.

31. Professor Kearnl acknowledges that it is uncertain whether the Kim model is capable of accounting for platform economic factors like tipping, particularly without the underlying data, which Dr. Leonard did not have:

Q. (By Ms. Hurst) So that kind of flipping or displacement might be called “tipping,” right?

A. Yeah, you know, and the model is not a tipping model. It has nothing that says, if you get past a certain point, then you go down a slippery slide. So it's not that kind of model. But one of them would redo -- reverse the order. Whether or not these changes would

³³ For a review of the application of these platform economic principles to the mobile phone market, *See* Bresnahan, Timothy, and Shane Greenstein. “Mobile computing: The next platform rivalry.” *The American Economic Review* 104.5 (2014): 475-480, p.7-8 (“Google entered with a purchase rather than its own development in a classic fast-follower strategy, with both defensive and offensive motives. Delay would have provided a longer opportunity to Apple, with the potential to gain such positive feedback that potentially no second entrant could succeed against. Delay also reduced the likelihood for success in competition with any other new potential entrant, or newly changed platform from among one of several established firms with the resources, such as Nokia, RIM or Microsoft. As it has turned out, events suggest fast entry was as important as the right choices over dimensions of platform differentiation.”); *see also*, “As Smartphones Proliferate, Will One Company Emerge as the Clear Market Winner?” Wharton (May 27, 2009). <http://knowledge.wharton.upenn.edu/article/as-smartphones-proliferate-will-one-company-emerge-as-the-clear-market-winner/>. (“Industry observers, including faculty at Wharton, generally agree that the smartphone market is at a tipping point ... Less clear is how the industry will evolve. Will the variety of mobile operating systems — the software that is the foundation for all the devices can do — be winnowed down to one or two, or will the Balkanization of mobile software hamper the growth of the industry?”).

be sufficient to reverse the order, I just don't know whether it's capable of doing it, or whether it does do it.

Q. And if you had Dr. Kim's data, would you be able to figure that

THE DEPONENT: I don't know. If I had Dr. Kim's underlying data, I could ask the question about whether or not I could do that. But I -- without seeing the data and without knowing sort of exactly what the data is, I don't know whether it's amenable to answering that question.³⁴

Thus, I find that Professor Kearl's adjustments of Dr. Leonard's premise (and model) for calculating market share-based damages do not and cannot fix this fundamental flaw in Dr. Leonard's model.

32. The estimates presented by Drs. Leonard and Kearl rely on consumer choice models without consideration of the role that the copying of the Java API packages had in Android's initial viability, which renders them incomplete. Each fails to account for the imperatives of platform economics.³⁵ In particular, the models do not describe the impact of first-mover advantage (early

³⁴ Deposition of Professor James Kearl, Mar. 23, 2016, p. 186:24-187:18.

³⁵ For a review of the importance of these platform economic principles, *see, e.g.* Shapiro, Carl, and Hal R. Varian. *Information Rules: A Strategic Guide to the Network Economy*. Harvard Business Press (2013), p.68 ("First-mover advantages can be powerful and long lasting in lock-in markets, especially those in information industries where scale economies are substantial"); *see also*, Eisenmann, Thomas R. "A note on racing to acquire customers." (2003), p. 1 ("The first company to enter a new market—the "first mover"—often has incentives to amass customers before it confronts competition. The payoff for preemption is especially strong in markets that exhibit increasing returns to scale due to network effects, learning effects, or high fixed costs."); *see also*, Lieberman, Marvin B. "Did first-mover advantage survive the dot-com crash." Anderson Graduate School of Management, UCLA (2005)., p. 8 ("The potential for network effects led many to anticipate strong first-mover advantages in Internet markets....Hence, in markets with network effects, the leading firm is likely to capture disproportionate returns.").

entry),³⁶ tipping points,³⁷ network effects,³⁸ expectations³⁹ or the substantial general risk of platform failure.⁴⁰

³⁶ See, e.g. Burrows, Peter, “iPhone vs Android: When It Comes To Wooing Developers, Don't Underestimate the First Mover Advantage.” *BusinessWeek*, (Sept. 25, 2008), https://web.archive.org/web/20080929011922/http://www.businessweek.com/technology/ByteOfTheApple/blog/archives/2008/09/iphone_vs_andro.html. (“[T]here’s another simple reality that will also determine who comes out ahead in this Battle of the Titans. It’s Apple’s first mover advantage. Already, thousands of developers have already created apps for the iPhone.... Had Apple and Google announced their SDK on the same day, these developers may have created versions for both right away. That didn’t happen, though. Since Android came nearly six months later than Apple ... many will likely take a “wait-and-see” approach to Android. That creates a chicken-and-egg conundrum for Android, seems to me. If top developers are waiting and seeing while iPhone sales zoom ahead, it could impact or at least temper Android’s ability to get off the ground... If Google can’t quickly start creating a network effect of its own, Android could become like all those early e-auction sites that never caught up with eBay... Trying to catch up with that can be an extremely difficult thing.”).

³⁷ Schmidt, Eric, World Economic Forum, Davos Annual Meeting, “Future of Mobile Technology,” (June 2008), <https://www.youtube.com/watch?v=XjjoJyIngg>. (“It’s very difficult to project these [makes upward sloping gesture] curves, these inflection curves. And what happens in the internet is that you hit a sufficiency point. You hit a point where there’s enough people. There was a point when fax machines were roughly, roughly 20% of people had fax machines. Then all of the sudden, everyone had a fax machine. These are generally known as tipping points. There are mathematical principles behind them.”); see also, Varian, Hal R. “Art of Standard Wars.” *California Management Review* 41.2 (1999): 8-32, p. 10 (“Network markets tend to tip towards the leading player, unless the other players coordinate to act quickly and decisively.”); see also, Marc Rysman, *The Economics of Two-Sided Markets*, 23(3) *J. Econ. Perspectives* 125 (2009), p. 137 (“Two-sided markets typically have network effects and as such are likely to tip toward a single dominant platform.”).

³⁸ A long literature has documented and measured the network effect “feedback loop” between hardware sales, software availability, and consumer adoption in platform markets whereby early availability of software drives hardware sales, which in turn spurs on future software availability (and so forth). See, e.g., Gandal, Neil, Michael Kende, and Rafael Rob. “The dynamics of technological adoption in hardware/software systems: The case of compact disc players.” *The RAND Journal of Economics* (2000): 43-61; see also, Dubé, Jean-Pierre H., Günter J. Hitsch, and Pradeep K. Chintagunta. “Tipping and concentration in markets with indirect network effects.” *Marketing Science* 29.2 (2010): 216-249; see also Lee, Robin, “Vertical Integration and Exclusivity in Platform and Two-Sided Markets,” *American Economic Review* 103.7 (2013).

³⁹ Professor Kearn described the importance of expectations in attracting developers to a platform. See Deposition of Professor James Kearn, Mar. 23, 2016, pg. 84:19-23. (“Answer: I -- I know no evidence on the causal relationship, so let me be clear about that. But -- but it's almost certainly true that this is a feedback cycle that -- that you don't write for platforms you think are going to fail.”); see also, Shapiro, Carl, and Hal R. Varian. *Information Rules: A Strategic Guide to the Network Economy*. Harvard Business Press (2013), p.224 (“Consumer expectations are vital to obtaining the critical mass necessary to fuel growth. During the early stages of product introduction, expectations management is critical.”); see also, Zhu, Feng, and Marco Iansiti. “Entry into platform - based markets,” *Strategic Management Journal* 33.1 (2012), p.89 (“The monopoly outcome occurs when consumers and developers hold favorable expectations of one platform with respect to its future market size—they believe that everyone else will adopt the same platform. As entrants lack installed bases, consumers tend to hold favorable expectations of established platforms.”).

⁴⁰ Evans, David S. and Richard Schmalensee, “Failure to Launch: Critical Mass in Platform Businesses,” *Review of Network Economics* 9.4 (2010), p.3 (“With strong network effects, new networks tend either to capture the entire market (e.g., Blu-Ray) or to fail completely (e.g., HD-DVD).”).

33. As I describe extensively in each of my reports, the copying of the Java API packages by Google was critical to the success of Android. Thus, Dr. Leonard's and Professor Kearn's estimates of infringer's profits do not capture the significant value provided by the Java APIs.

VI. CONCLUSION

34. As I describe above, the use of non-infringing alternatives in copyright disgorgement is inappropriate because it is inconsistent with the economic incentives that the disgorgement remedy is meant to provide. Additionally, Professor Kearn's reliance on Dr. Leonard's application of the Kim model—which continues to ignore critical aspects of platform economics such as tipping, is unreliable. The adjustments Professor Kearn performs to Dr. Leonard's analysis do not fix the fundamental error, which is that the Kim model presumes the success of Android, and Dr. Leonard attempts to apply it in a period when Android's future existence was highly uncertain.

APPENDIX A

ADAM B. JAFFE

PROFESSIONAL EXPERIENCE

Motu Economic and Public Policy Research, Wellington, New Zealand

Director, May 2013 ongoing

Te Pūnaha Matatini Centre of Research Excellence

Economics and Social Science Research Theme Leader, 2014 ongoing

Queensland University of Technology

Adjunct Professor, 2015 ongoing

Auckland University Business School

Sir Douglas Myers Visiting Professor, 2014

Brandeis University, Faculty of Arts and Sciences and International Business School, Waltham, MA

Fred C. Hecht Professor in Economics Emeritus, 2014 onward

Research Professor, 2014 onward

Fred C. Hecht Professor in Economics, 1999 - 2014

Dean of Arts and Sciences, July 2003 to June 2011

Chair, Department of Economics, 2000 - 2002

Associate Professor of Economics, 1994 - 1999

Chair, Brandeis Intellectual Property Policy Committee, 2001 - 2003

Member, University Advisory Council, 2001 - 2011

National Bureau of Economic Research

Faculty Research Fellow (1985-1994) and then Research Associate (1995 onward)

*Co-founder and Co-organizer, Science and Technology Policy Research Workshop (1995-98) and
Innovation Policy and the Economy Group (1999-2007)*

*Project Coordinator, NBER Research Project on Industrial Technology and Productivity, 1994-
1999 (funded by the Alfred P. Sloan Foundation)*

Organization for Economic Cooperation and Development (OECD), Paris

2002-2003 *Visitor, Directorate for Science, Technology and Industry*

Economics Resource Group, Inc.

1988-1999 Founding partner

Harvard University, Faculty of Arts and Sciences, Cambridge, MA

Associate Professor of Economics, 1989 - 1994

Assistant Professor of Economics, 1985 - 1989

visiting the Kennedy School of Government, 1992-94

President's Council of Economic Advisers, Washington, DC

Senior Staff Economist, 1990 - 1991

EDUCATION

Harvard University, Cambridge, MA

Ph.D. in Economics, 1985

Dissertation: “Quantifying the Effects of Technological Opportunity and Research Spillovers in Industrial Innovation”

Massachusetts Institute of Technology, Cambridge, MA

S.M. in Technology and Policy, 1978

Thesis: “Regulating Chemicals: Product and Process Technology as a Determinant of the Compliance Response”

S.B. in Chemistry, 1976

TESTIMONY AND CONSULTING EXPERIENCE

Television Music License Committee, Radio Music License Committee, Viacom, Inc. and Netflix, Inc (Weil, Gotshal & Manges, New York)

Prepared written comments and attended consultation at the U.S. Department of Justice
Antitrust Consent Decree Review –ASCAP and BMI 2014

Television Music License Committee (Weil, Gotshal & Manges, New York)

UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF NEW YORK, MEREDITH CORPORATION, THE E.W. SCRIPPS COMPANY, SCRIPPS MEDIA, INC., HOAK MEDIA, LLC, HOAK MEDIA OF NEBRASKA LLC, and HOAK MEDIA OF DAKOTA, LLC, v SESAC LLC and JOHN DOES 1–50, 09 Civ. 9177 (PAE); Written Expert Report (March 2013); Deposition (April 2013)

Television Music License Committee (Weil, Gotshal & Manges, New York)

United States District Court, Southern District of New York, WPIX, Inc., et al, against Broadcast Music, Inc., 09 Civ. 10366 (LSS), Expert Report, December 23, 2011; Rebuttal Report January 30, 2012; Deposition March 6, 2012

Enbridge Southern Lights pipeline (Steptoe and Johnson, Washington DC)

U.S. Federal Energy Regulatory Commission Docket Nos. IS11-146-000, IS10-399-000, IS10-399-001, IS10-399-003 (Consolidated), Prepared Rebuttal Testimony, November 1, 2011; Oral Testimony January 10, 2012

Enbridge Southern Lights pipeline (MacLeod Dixon, Calgary)

National Energy Board of Canada, Hearing Order RH-1-2011, Written Reply Evidence, October 6, 2011; Oral Testimony November 17, 2011

Teva Pharmaceuticals USA, Inc. (Goodwin, Proctor, Boston)

United States District Court, Southern District of New York, Teva Pharmaceuticals, et al, v Mylan Pharmaceuticals, et a 09 CV 8824, Expert Report, December 2010, Deposition January 2011

DMX, Inc. (Weil, Gotshal & Manges, New York)

United States District Court, Southern District of New York, United States v. American Society of Composers, Authors, and Publishers (In re Application of THP Capstar Acquisition Corp.), 09 Civ. 7069 (DLC), Expert Report, July 2010; Rebuttal Expert Report, August 2010; Deposition, August 31, 2010; Trial Testimony November 2010.

DMX, Inc. (Weil, Gotshal & Manges, New York)

United States District Court, Southern District of New York, Broadcast Music, Inc. against DMX, Inc., 08 Civ. 216 (LLS), Interim Phase Declaration, August 2008; Interim Phase Deposition, September 2008; Interim Phase Reply Declaration, October 2008, Declaration, August 14, 2009, Deposition, September 14, 2009; Trial Testimony January 2010.

Teva Pharmaceuticals USA, Inc. (Brinks Hofer Gilson & Lione, Chicago)

United States District Court, Southern District of New Jersey, Merck, Sharpe and Dohme Pharmaceuticals SRL v. Teva Pharmaceuticals USA, Inc., expert Report, September 2008; Deposition December 2008, trial testimony February 2009.

Ariba, Inc. (Heller, Ehrman, San Francisco)

In the United States District Court for the District of Massachusetts, Sky Technologies, LLC v. Ariba, Inc., Written Expert Report, July 27, 2007

Finance Ministry, Government of Chile (Santiago, Chile)

Consultation on the development of innovation policy for Chile (2007)

Pro Se Testimony

Before the US House of Representatives, Committee on the Judiciary, Subcommittee on Courts, the Internet and Intellectual Property. Oversight Hearing on the Patent System, "American Innovation at Risk: The Case for Patent Reform." February 15, 2007.

A Group of Internet Webcasters and Radio Broadcasters (Weil, Gotshal & Manges, New York) *Before the Copyright Royalty Board, Library of Congress, Washington, DC; in the Matter of: Digital Performance Right in Sound Recordings and Ephemeral Recordings. Docket No. 2005-1 CRB DTRA.* Testimony October 31, 2005; Oral Testimony June 26, 2006; Rebuttal Testimony on Behalf of Internet Webcasters and Radio Broadcasters September 29, 2006; Rebuttal Testimony on behalf of National Public Radio September 29, 2006; Oral Rebuttal Testimony, November 8, 2006. The World Bank (Washington, DC)

The World Bank (Washington, DC)

Consultant regarding project evaluation methodologies for project on financial support for commercial innovation in El Salvadore

Television Music License Committee (Weil, Gotshal & Manges, New York)

Before the American Arbitration Association, SESAC, Inc. against Television Music License Committee. Expert Report, December 2, 2005; Oral Testimony, January 25, 2006

Television Music License Committee (Weil, Gotshal & Manges, New York)

In the United States District Court, Southern District of New York, United States of America against American Society of Composers, Authors, and Publishers, In the Matter of the Application of Post-Newsweek Stations, Inc., et al., Applicants, For the Determination of Reasonable License Fees, 41 Civ. 1395 (WCC) (MHD). Expert Report March 17, 2004; Deposition May 14, 2004; Rebuttal Expert Report June 18, 2004; Deposition July 22, 2004.

Pharmaceutical Care Management Association (Steptoe & Johnson, Washington, DC)

In the United States District Court for the District of Maine, Pharmaceutical Care Management Association v. G. Steven Rowe, in his official capacity of Attorney General of the State of Maine. Declaration, September 2, 2003.

Castano Tobacco Litigation Plaintiff's Legal Committee (Murray Law Firm, New Orleans)

In the Civil District Court for the Parish of Orleans, State of Louisiana, Gloria Scott and Deania M. Jackson, et al., vs. The American Tobacco Company, Inc., et al. Expert Report, June 6, 2000; Deposition, October 18, 2000; Oral Trial Testimony, January 30, February 4-5, 2003.

Television Music License Committee (Weil, Gotshal & Manges, New York)

Before the American Arbitration Association, SESAC, Inc., against Television Music License Committee. Economic analysis of a reasonable license fee for public performance of SESAC music. Expert Report, January 11, 2002.

Phillips Transportation Alaska, Inc. (Birch, Horton, Bittner and Cherot, Anchorage)

State of Alaska, The Regulatory Commission of Alaska, In the Matter of the Application of BP Pipelines (Alaska), Inc. and Phillips Transportation Alaska, Inc., for the Transfer of 3.0845%

Interest in the TAPS System. Affidavit (with Lisa J. Cameron) evaluating the competitive impact of a proposed sale of capacity on the Trans Alaska Pipeline System from BP Pipelines (Alaska), Inc., to Phillips Transportation Alaska, Inc., May 25, 2001; Supplemental Affidavit (with Lisa J. Cameron), July 10, 2001.

SFPP, L.P. (Vinson & Elkins, Houston)

United States of America before the Federal Energy Regulatory Commission, In the Matter of ARCO Products Company, et al., v. SFPP, L.P. Prepared Answering Testimony evaluating whether there has been a substantial change in the economic circumstances that were the basis for interstate rates, May 15, 2001; Reply Testimony, July 31, 2001; Oral Testimony, October 25-26, 2001; Supplemental Testimony, February 20, 2002.

A group of internet broadcasters (Weil, Gotshal & Manges, New York; Wiley, Rein & Fielding, Washington, DC)

Before the United States Copyright Office, Library of Congress, in the Matter of Digital Performance Right in Sound Recordings and Ephemeral Recordings. Direct Testimony in an arbitration proceeding involving the valuation of the right of public performance of digital sound recordings and ephemeral recordings, April 11, 2001; Oral Testimony, August 27-28, 2001; Written Rebuttal Testimony, October 4, 2001; Oral Rebuttal Testimony, October 19-20, 2001.

The Burlington Northern and Santa Fe Railway Company (Steptoe & Johnson, Washington, DC)
Before the American Arbitration Association, Tucson Electric Power Company, Claimant, v. Burlington Northern and Santa Fe Railway Company, Respondent. Direct testimony in an arbitration proceeding concerning a coal transportation contract, January 26, 2001; Deposition, February 9, 2001.

Cheminova A/S (Beveridge & Diamond, Washington, DC)

Before the American Arbitration Association, In The Matter of Arbitration Between Cheminova A/S, Claimant and Griffin LLC, Respondent, Docket No. 23 171 00020 99. Direct Oral Testimony in a data compensation case concerning a pesticide, December 7, 2000; Oral Rebuttal Testimony, December 9, 2000.

Music Choice (Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, Washington, DC)

In the United States District Court, Southern District of New York, United States of America against Broadcast Music, Inc., et ano., In the Matter of the Application of Music Choice, et al., Applicants, for the Determination of Reasonable License Fees. Affidavit, July 28, 2000; Expert Report, January 26, 2001; Supplemental Expert Report, March 9, 2001; Deposition, March 28, 2001; Affidavit, April 9, 2001; Oral Testimony, May 29, 2001.

Wilson-Cook Medical Incorporated (Brinks Hofer Gilson & Lione, Chicago)

In the United States District Court for the District of Massachusetts, Boston Scientific Corporation and SCIMED Life Systems, Inc., v. Wilson-Cook Medical Incorporated. Expert Report analyzing irreparable harm related to preliminary injunction in a patent infringement

case, July 26, 2000; Deposition, July 27, 2000; Supplemental Expert Report, September 15, 2000.

Owens-Corning (Forman, Perry, Watkins, Krutz & Tardy, Jackson, MS)

In the Circuit Court of Jefferson County, Mississippi, Ezell Thomas, et al. (as to all defendants) and Owens-Corning (as to tobacco defendants only) versus R.J. Reynolds Tobacco Company, et al., and Amchem Products, Inc., et al. Expert Report prepared on behalf of Owens Corning in tobacco litigation, June 14, 2000; Deposition, September 13, 2000.

Ellis Simon, et al. (Brown, Rudnick, Freed & Gesmer, Boston)

In the United States District Court, Eastern District of New York, Ellis Simon, et al., v. Philip Morris Incorporated, et al., CV-99-1988, First Amended Class Action Complaint. Testimony on behalf of the plaintiffs in tobacco litigation; Expert Disclosure Statement, December 20, 1999; Deposition, February 28, 2000; Affidavit, April 13, 2000.

Vastar Resources, Inc.

Before the United States of America, Department of the Interior, Minerals Management Service, Further Supplementary Proposed Rule for Establishing Oil Value for Royalty Due on Federal Leases, Affidavit, January 31, 2000. *Before the United States of America, Department of the Interior, Minerals Management Service, Vastar Resources, Inc.'s Request for a Binding Value Determination on Transportation Allowances*, Affidavit April 4, 2000. Testimony on behalf of Vastar Resources, Inc., on issues related to the appropriateness and reasonableness of various methodologies that may be employed for the purpose of determining transportation allowances to be used for royalty payments from federal leases.

Pharmaceutical Research and Manufacturers of America

Prepared research report entitled "Consequences of Pharmaceutical Price Controls on Innovation" (with Catherine Moore), May 1999.

PacifiCorp (Stoel Rives, Portland, OR)

Before the Public Utility Commission of Oregon, UE 102, In the Matter of the Application of Portland General Electric Company for Approval of the Customer Choice Plan. Testimony on behalf of PacifiCorp regarding the company's eligibility to participate in an auction of generation assets, April 26, 1999.

Turner Broadcasting System, Inc., et al. (Weil, Gotshal & Manges, New York)

In the United States District Court, Southern District of New York, United States of America against American Society of Composers, Authors, and Publishers, In the Matter of the Application of Turner Broadcasting System, Inc., et al., Applicants, For the Determination of Reasonable License Fees, CIV. NO. 13-95 (WCC), Expert Report prepared on behalf of the applicants in litigation about music licensing fees, April 16, 1999; Deposition, July 26-27, 1999; Rebuttal Expert Report, December 16, 1999; Deposition, March 3, 2000.

The American Chemical Society

Developed and evaluated a number of approaches to pricing the web editions of ACS's publications. Modeled the performance of the various pricing plans to assess their ability to protect ACS's publications revenue as web editions replace paper. (1999)

Copyright Clearance Center, Inc. (Weil, Gotshal & Manges, New York, NY)

Primary consultant on statistical and economic matters since 1985. (ongoing)

Procter & Gamble, Inc. (Torys, Toronto)

In the Matter Between Unilever PLC. and Lever Brothers Limited, Plaintiffs, and Procter & Gamble, Inc., and the Procter & Gamble Company, Defendants, Court File No. T-2534-85, Expert Report prepared on behalf of the defendants in patent dispute, January 11, 1999; Reply Report, January 29, 1999; Oral Testimony, December 6-7, 1999.

Ironworkers Local Union No. 17 Insurance Fund and its Trustees (Milberg, Weiss, Bershad, Hynes & Lerach, San Diego)

Ironworkers Local Union No. 17 Insurance Fund and its Trustees, et al., vs. Philip Morris, Inc., et al. (Ohio), Expert Report prepared on behalf of the plaintiffs in tobacco litigation, November 6, 1998; Supplemental Report, December 17, 1998; Deposition, January 11 and 21, 1999; Oral Testimony, February 23, 1999.

State of Wisconsin (Habush, Habush, Davis & Rottier, Milwaukee)

The State of Wisconsin v. Philip Morris, et al. Prepared Expert Witness Report on behalf of the plaintiffs in tobacco litigation, November 1, 1998.

Trans-Alaska Pipeline (Steptoe & Johnson, Washington, DC)

In the Matter of the Correct Calculation and Use of Acceptable Input Data to Calculate the 1997, 1998, 1999, 2000 and 2001 Tariff Rates for the Intrastate Transportation of Petroleum over the Trans Alaska Pipeline System Filed by Amerada Hess Pipeline Corporation; Arco Transportation Alaska, Inc.; BP Pipelines (Alaska) Inc.; Exxon Pipeline Company; Mobil Alaska Pipeline Company; Phillips Alaska Pipeline Corporation; Unocal Pipeline Company; Phillips Transportation Alaska, Inc.; and Williams Alaska Pipeline Company, LLC, and the Protest by Tesoro Alaska Petroleum Company of the 1997 and 1999 Tariff Rates, Before the Regulatory Commission of Alaska, Docket No. P-97-4. Prepared Direct Testimony evaluating whether the TAPS Intrastate Settlement and the ratemaking methodology it established produce tariff rates that are just and reasonable, October 8, 1998; Second Prepared Direct Testimony, July 12, 2000; Prepared Rebuttal Testimony, February 26, 2001; Oral Testimony, April 10-13, 2001.

Commonwealth of Massachusetts (Brown, Rudnick, Freed & Gesmer, Boston)

The Commonwealth of Massachusetts vs. Philip Morris Incorporated, et al., Civil Action Number 95-7378. Prepared Expert Disclosure Report on behalf of the plaintiffs in tobacco litigation, June 16, 1998; Affidavit in Opposition to Defendants' Motions for Summary Judgement, October 30, 1998.

CBS (Weil, Gotshal & Manges, New York)

CBS Inc. v. American Society of Composers, Authors & Publishers, New York State Supreme Court, New York County. Prepared Expert Report regarding timing of payments under ASCAP agreements, August 11, 1997; Deposition, June 12, 1998; Addendum to Prepared Expert Report, December 1, 1998; Supplemental Deposition, January 28, 1999.

Public Broadcasting System, National Public Radio, and the Corporation for Public Broadcasting (Weil, Gotshal & Manges, New York)

Prepared testimony regarding royalties for copyrighted musical compositions, *In the Matter of the Rates for Noncommercial Educational Broadcasting Compulsory License, Before the Copyright Arbitration Royalty Panels, Docket No. 96-6, CARP NCBRA*, 1997. Written Testimony, April 1, 1998; Oral Testimony, April 1-2, 1998; Rebuttal Testimony, April 15, 1998; Oral Rebuttal Testimony, May 7, 1998.

State of Minnesota (Robins, Kaplan, Miller & Ciresi, Minneapolis)

The State of Minnesota and Blue Cross and Blue Shield of Minnesota vs. Philip Morris Incorporated, et al., Court File No. C1-94-8565. Prepared Expert Witness Report on behalf of the plaintiffs in antitrust litigation involving allegations of collusive conspiracy, May 29, 1997; Deposition, June 26-27, 1997; Oral Trial Testimony, March 18-23, 1998.

PacifiCorp (Stoel Rives, Portland, OR)

PacifiCorp, Electric Restructuring Transition Plan, Before the Montana Public Service Commission, Docket No. D97.7.91. Prepared Prefiled Rebuttal Testimony evaluating testimony regarding market power in the generation of electricity in Montana, February 24, 1998; Prefiled Surrebuttal Testimony, July 21, 1998.

PacifiCorp (Stoel Rives, Salt Lake City)

United States District Court for the District of Idaho, Snake River Valley Electric Association v. PacifiCorp, Case No. CV 96-0308-E-BLW. Testimony analyzing allegations of anticompetitive behavior and evaluating market power. Expert Witness Statement, October 17, 1997; Affidavit, February 27, 1998; Expert Report, January 22, 2002; Supplement to the Expert Report, April 8, 2002; Revised Supplement to the Expert Report, August 15, 2002; Affidavit, September 18, 2002; Oral Testimony, September 20, 2002, October 15, 2002.

Trans-Alaska Pipeline (Steptoe & Johnson, Washington, DC)

Prepared Affidavit and Rebuttal Affidavit evaluating the competitive impact of the Amended and Restated Capacity Settlement Agreement, *Exxon Pipeline Co., et al., Application of TAPS Carriers for Approval of Amended and Restated Capacity Settlement Agreement, Before the Federal Energy Regulatory Commission, Docket No. OR96-1-000, et al.* (1997)

The Burlington Northern and Santa Fe Railway Company (Steptoe & Johnson, Washington, DC)
Prepared Verified Statement regarding market power in transporting coal, *In the Matter of Western Fuels Service Corporation v. The Burlington Northern and Santa Fe Railway Company, Before the Surface Transportation Board, STB Docket No. 41987*. (1997)

PacifiCorp (Stoel Rives, Portland, OR)

Assisted in FTC pre-merger Hart-Scott-Rodino review; prepared *Economic Analysis of Alleged Vertical Market Power Consequences of Merger of PacifiCorp and Peabody Coal*. (1997)

Subaru of New England, Inc. (Todd & Weld, Boston)

Subaru of New England, Inc., vs. Subaru of Wakefield, Inc., Civil Action No. 96-01475-A, Commonwealth of Massachusetts, Norfolk County, Superior Court Department. Prepared Affidavit regarding appropriate methodology for assessing competitive impact of dealer relocation, November 20, 1996.

Public Service Company of New Hampshire

Direct testimony before the State of New Hampshire Public Utilities Commission, Docket No. DR 96-150, Electric Industry Restructuring, with Joseph P. Kalt, October 18, 1996.

Pro Se Testimony

United States of America before the Federal Energy Regulatory Commission “Alternatives to Traditional Cost-of-Service Ratemaking for Natural Gas Pipelines, Regulation of Negotiated Transportation Services of Natural Gas Pipelines,” Docket No. RM-96-7-000. Comments of Adam B. Jaffe and Joseph P. Kalt, May 30, 1996.

Massachusetts Technology Collaborative

Prepared a study assessing the effects of reductions in federally funded R&D on the Massachusetts economy. (1995-96)

Federal Trade Commission

Asked by Commission staff to prepare testimony for Hart-Scott-Rodino preliminary injunction hearing regarding anticompetitive impact of a proposed acquisition. (1995)

GAF Corporation, *et al.* (Hannoch Weisman, Roseland, NJ)

Joseph Rossi, et al., vs. Standard Roofing, et al., Civil Action No. 92-5377, United States District Court, District of New Jersey. Prepared Expert Witness Report on behalf of six defendants in antitrust litigation involving conspiracy and monopolization claims. (1995)

Connecticut Light and Power Company

Before the Connecticut Department of Public Utility Control, Investigation into Restructuring of the Electric Industry, Docket No. 94-12-13. Submitted Written and Oral Hearing Testimony. (1995)

New England X-Ray & Electronics Inc. (Kushner & Sanders, Wellesley, MA)

New England X-Ray & Electronics Inc. vs. Robert T. Kennedy, Inc., et al., Commonwealth of Massachusetts, Number 88-5532. Presented damages study and jury trial testimony regarding breach of contract. (1990-95)

Florida Gas Transmission Company

Before the Federal Energy Regulatory Commission, Docket No. RP95-103-000, Written Testimony supporting FGT's proposed flexible service offerings, inflation-indexed rate, and removal of regulatory constraints on the secondary market for pipeline capacity. (1995)

Burlington Northern Railroad Company (Steptoe & Johnson, Washington, DC)

Southwestern Electric Power Company, Plaintiff, vs. Burlington Northern Railroad Company, Defendant, in the 102nd Judicial District Court of Bowie County, Texas, No. D-102-CV-91-720. Presented Oral Trial Testimony before a state court jury regarding the pricing provisions in two long-term coal transportation agreements, in defense against a claim by the shipper of overcharges resulting from the contract rates failing to reflect the railroads' productivity improvements. (1994)

Houston Lighting & Power Company

Before the Texas Public Utilities Commission, Docket No. 12065, Written Testimony regarding appropriate regulatory policy changes dictated by emerging competition in electricity markets. (1994)

Boston Ventures Management (Boston)

Prepared a report for a venture capital firm on the adverse consequences on investment of the re-regulation of cable TV. (1994)

Kern River Gas Transmission Company (Salt Lake City)

Before the Public Service Commission of Utah, Application of Mountain Fuel Supply Company for Approval of Modifications to its Tariff to Implement a Firm Transportation Rate, Docket No. 94-057-02. Prepared Prefiled Direct and Rebuttal Testimony, as well as Oral Testimony, before the Public Service Commission of Utah regarding the appropriateness of a firm gas distribution tariff including within it costs of upstream pipeline transportation. (1994)

Burlington Northern Railroad Company (Steptoe & Johnson, Washington, DC)

In the Matter of the Arbitration between Public Service Company of Oklahoma and Burlington Northern Railroad Company. Delivered Written and Oral Testimony concerning the interpretation of the pricing and renegotiation provisions of a long-term coal transportation agreement. (1994)

Arco Pipe Line Company (Steptoe & Johnson, Washington, DC)

Prepared written *Comments in Response to Notice of Inquiry, Market-Based Ratemaking for Oil Pipelines, U.S. Federal Energy Regulatory Commission, Docket No. RM94-1-000*. (1994)

Kern River Gas Transmission Company (Wright and Talisman, Washington, DC)

Before the Federal Energy Regulatory Commission In the Matter of Kern River Gas Transmission Company, Docket No. RP92-226-000. Delivered Written and Oral Testimony regarding rate design for pipelines built under optional certificates. (1993)

ISK Biotech Corp. (Beveridge and Diamond, Washington, DC)

In the Matter of the Arbitration between ISK Biotech Corporation and Veterans Chemicals, Prepared Testimony regarding allocation rules and competitive impacts in an arbitration proceeding regarding data compensation under the Federal Insecticide, Fungicide and Rodenticide Act. (1993)

Geneva Steel Corp., *et al.* (Kimball, Parr, Waddoups, Brown & Gee, Salt Lake City)

Before the Utah Public Service Commission Docket No. 93-057-01, Written Testimony regarding antitrust implications of LDC treatment of pipeline charges under FERC Order 636, on behalf of a coalition of interruptible shippers. (1993)

Enron Gas Services Corp.

Co-authored study analyzing appropriate Public Utility Commission policy towards utility procurement of natural gas and emissions allowances in developing competitive markets. (1993)

New York Power Authority

Prepared analysis and delivered Public Hearing Testimony before the Board of Trustees regarding the economic consequences of below-market pricing for electricity. (1993)

Coalition of Non-Utility Generators

Co-authored study analyzing the effect of power from non-utility generators on electricity prices in New England. (1993)

U.S. Department of Commerce, Economics and Statistics Administration

Co-authored study analyzing the effect of U.S. environmental regulations on U.S. competitiveness. (1993)

International Energy Group

Before the Federal Energy Regulatory Commission, Docket No. PL91-1-000, Prepared Written Testimony regarding electricity transmission access policy. (June 1991)

El Paso Natural Gas Co. (Andrews & Kurth, Washington, DC)

Before the Federal Energy Regulatory Commission, Docket No. CP88-434-000, Prepared Written Testimony analyzing the extent of competition faced by El Paso as a seller of natural gas. (1989)

RECENT INVITED TALKS

“Evaluating the Performance of Public Research Subsidy Programmes,” RIETI-NISTEP Policy Symposium, Tokyo, August 2015

“Promoting Innovation in the Private Sector,” Harvard/Tsinghua Workshop on Energy Technology Innovation Policy in the Backdrop of the US/China Emissions Deal, Beijing, June 2015

“The Economics of Science and Science Policy,” Speakers Science Series, New Zealand Parliament, December 2014

“Innovation Policy for Australasia,” Dimensions of Innovation Conference, Queensland University of Technology, October 2014

“Re-inventing the Kiwi: How to make New Zealand a land of innovation,” Dean’s Distinguished Speaker Series, University of Auckland Business School, August 2014

“Small Countries in the Global Innovation System,” Australian Conference of Economists, Hobart, July 2014

“Measuring the Effect of Government Research Funding: Regression-discontinuity Analysis of the NZ Marsden Fund,” Melbourne Institute of Applied Economic and Social Research, July 2014

“Technology Policy and Climate Change,” invited seminar at Research Institute of Economy Trade and Industry (REITI), Tokyo, March 2014

BOOKS AND EDITED VOLUMES

The Changing Frontier: Rethinking Science and Innovation Policy (with Benjamin Jones), University of Chicago Press, 2015

Innovation and its Discontents (with J. Lerner), Princeton University Press, 2004; issued in paperback, 2006.

Patents, Citations and Innovations: A Window on the Knowledge Economy (with M. Trajtenberg), M.I.T. Press, 2002; issued in paperback, 2005.

Innovation Policy and the Economy, (edited with J. Lerner and S. Stern), M.I.T. Press, Cambridge, Volume 1 (2001) through Volume 8 (2008)

OTHER PUBLICATIONS

“Patent Citation Data in Social Science Research: Overview and Best Practices” (with Gaétan de Rassenfosse), NBER Working Paper No. 21868 (2016)

“Agricultural productivity in New Zealand: First estimates from the Longitudinal Business Database” (with Eyal Apatov, Richard Fabling, Michele Morris, and Matt Thirkettle), Motu Working Paper 15-13 (2015)

“The Effect of Public Funding on Research Output: the New Zealand Marsden Fund” (with Jason Gush, Victoria Larsen and Athene Laws), Motu Working Paper 15-12 and NBER Working Paper No. 21652 (2015)

“The Impact of R&D Subsidy on Innovation: a Study of New Zealand Firms” (with Trinh Le), Motu Working Paper 15-08; National Bureau of Economic Research Working Paper No. 21479 (2015)

“Technology Diffusion,” in *Emerging Trends in the Social and Behavioral Sciences*, Robert A. Scott and Stephen M. Kosslyn, eds, Wiley Online Library: DOI: 10.1002/9781118900772 (2015)

“Innovation,” in *Emerging Trends in the Social and Behavioral Sciences*, Robert A. Scott and Stephen M. Kosslyn, eds, Wiley Online Library: DOI: 10.1002/9781118900772 (2015)

“The science, economics and politics of global climate change,” Review of The Climate Casino, by William Nordhaus (with S. Kerr), *Journal of Economic Literature*, 2015

“Science and Innovation in Small Countries: Speculation and Research Agenda,” *Asia-Pacific Journal of Accounting and Economics*, <http://dx.doi.org/10.1080/16081625.2015.1010267> 2015

“Are Patent Fees Effective at Weeding out Low-quality Patents?” (with Gaétan de Rassenfosse) Motu Working Paper 15-01; NBER Working Paper No. 20785, December 2014

“Category 5 or Tempest in a Teapot?” Review of Falling Behind? Boom, Bust and the Global Race for Scientific Talent by Michael S. Teitelbaum, *Science*, 2 May 2014

“Diffusion of Green Technology” (with C. Allan and I. Sin), *International Review of Environmental and Resource Economics*, 7: 1–33 (2014)

“Lessons from the Economics Literature on the Likely Consequences of International Harmonization of IPR Protection” (with A.G.Z. Hu), in Intellectual Property Rights: Legal and Economic Challenges for Development, M. Cimoli, G. Dosi, K. Maskus, R. Okediji, and J. Reichman, eds, Oxford University Press, 2014

“Science and Innovation Policy for New Zealand,” *New Zealand Science Review*, 70 (3) 55, 2013

“Technology Policy and Climate Change,” *Climate Change Economics*, 2013

“Induced Innovation and Technology Trajectory: Evidence from Smoking Cessation Products” (with S. Werfel), *Research Policy*, 2013

“Comment on “The Diffusion of Scientific Knowledge Across Time and Space: Evidence from Professional Transitions for the Superstars of Medicine,” in J. Lerner and S. Stern, eds., **Rate and Direction of Inventive Activity**, University of Chicago Press, 2012

“Comment: The Economics of Technologies to Combat Global Warming,” *Energy Economics*, 33:4, 2011

“Analysis of Public Research, Industrial R&D, and Commercial Innovation: Measurement Issues Underlying the Science of Science Policy,” in **The Science of Science Policy: A Handbook**, K. Fealing, J. Lane, J. Marburger and S. Shipp, eds., Stanford: Stanford Business Books, 2011

“Energy, the Environment and Technology Change” (with D. Popp and R. Newell), in B. Hall and N. Rosenberg, eds, **Handbook of The Economics of Innovation**, North-Holland, 2010

“The US Patent System: Does It Strengthen or Weaken Innovation and Progress?” (with J. Lerner), Chapter 2.2 of *The Innovation for Development Report 2009-2010: Strengthening Innovation for the Prosperity of Nations*, Augusto López-Claros, ed, Palgrave MacMillan, 2009

“Patent Reform: No Time Like the Present,” *I/S Journal of Law and Policy for the Information Society*, 2008

“The ‘Science of Science Policy’,” *Journal of Technology Transfer*, 2008

“Double Research Funding? Be Careful,” *The Scientist*, Vol. 21 No. 7, page 31, 2007

“Academic science and entrepreneurship: Dual engines of growth?” (with J. Lerner, S. Stern and M. Thursby), *Journal of Economic Behavior and Organization*, 2007

“Peanut Butter Patents Versus the New Economy: Does the Increased Rate of Patenting Signal More Invention or Just Lower Standards?” (with P. Sanyal). *Annales d’Economie et de Statistique*, 2006

“The effects of economic and policy incentives on carbon mitigation technologies,” (with R. Newell and R. Stavins), *Energy Economics* 28, no. 5-6: 563-578, 2006.

“Public Financial Support for Commercial Innovation” (with I. Goldberg, M. Trajtenberg, T. Muller, J. Sunderland and E. Armas), World Bank. 2006.

“Innovation and Its Discontents” (with J. Lerner), in *Innovation Policy and the Economy Volume 6*, A. Jaffe, J. Lerner and S. Stern, eds., 2006; reprinted in *Capitalism and Society* Vol. 1 No. 3 (2006) and in **Perspectives on Commercializing Innovation**, F. Kieff and Troy Paredes, eds., Cambridge University Press (2012)

“Do Alliances Promote Knowledge Flows” (with B. Gomes-Casseres and John Hagedoorn), *The Journal of Financial Economics*, 2006.

“A tale of two market failures: technology and environmental policy” (with R. Newell and R. Stavins), *Ecological Economics*, 2005, reprinted in **Intellectual Property, Innovation and the Environment**, Peter Menell and Sarah Tran, eds., Edward Elgar (2013).

“Market Value and Patent Citations: A First Look” (with B. Hall and M. Trajtenberg), *Rand Journal of Economics*, 2005

Comment on “Patent Citations and the Geography of Spillovers: A Reassessment” (with R. Henderson and M. Trajtenberg), *American Economic Review*, 2005

“Economics of Energy Conservation” (with R.G. Newell and R. N. Stavins), in Cutler Cleveland, ed., *Encyclopedia of Energy*, Elsevier, Inc. 2004.

“Patent Citations and International Knowledge Flow: The Cases of Korea and Taiwan” (with A. Hu), *International Journal of Industrial Organization*, 2004

“Technological Change and the Environment” (with R. Newell and R. Stavins), in K.-G. Mäler and J. Vincent, eds., *Handbook of Environmental Economics*, North-Holland, 2003.

“Environmental Policy and Technological Change” (with R. Newell and R. Stavins), *Environmental and Resource Economics*, 2002.

“Building Programme Evaluation into the Design of Public Research-Support Programmes,” *Oxford Review of Economic Policy*, 2002.

“Reinventing Public R&D: Patent Policy and the Commercialization of National Laboratory Technologies” (with J. Lerner), *Rand Journal of Economics*, Spring 2001.

“International Taxation and the Location of Incentive Activity” (with J.R. Hines, Jr.), in J.R. Hines, Jr., ed., *International Taxation and Multinational Activity*, University of Chicago Press, 2001.

“Knowledge Spillovers and Patent Citations: Evidence from a Survey of Inventors” (with M. Trajtenberg and M. Fogarty), *American Economic Review Papers and Proceedings*, May 2000.

“The Cigarette Industry,” in W. Adams and J. Brock, eds., *The Structure of American Industry*, 10th edition, Prentice Hall, 2000.

“The U.S. Patent System in Transition: Policy Innovation and the Innovation Process,” *Research Policy*, April 2000.

“Energy-Efficient Technologies and Climate Change Policies: Issues and Evidence” (with R. Newell and R. Stavins), Resources for the Future Climate Issue Brief No. 19, December 1999.

“The Regional Economic Impact of Public Research Funding: A Case Study of Massachusetts” (with A.B. Candell), in L.M. Branscomb, F. Kodama, and R. Florida, eds., *Industrializing Knowledge: University-Industry Linkages in Japan and the United States*, MIT Press, 1999.

“The Induced Innovation Hypothesis and Energy-Saving Technological Change” (with R. Newell and R. Stavins), *Quarterly Journal of Economics*, August 1999; reprinted in A. Grübler, N. Nakicenovic, and W. Nordhaus, eds., *Technological Change and the Environment*, Resources for the Future, 2002.

“The Pipeline’s View: FERC’s Proposed Rule Misses” (with J. Lukens), *Public Utilities Fortnightly*, July 1, 1999.

“Special Issue on Geography and Innovation” (with R. Henderson), introduction to *Economics of Innovation and New Technology*, Vol. 8, 1999.

“International Knowledge Flows: Evidence from Patent Citations” (with M. Trajtenberg), *Economics of Innovation and New Technology*, Vol. 8, 1999.

Comment on “Inventors, Firms and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries,” in D. Raff, N. Lamoreaux and P. Temin, eds., *Learning by Doing in Markets, Firms, and Nations*, The University of Chicago Press, 1999.

“The Importance of ‘Spillovers’ in the Policy Mission of the Advanced Technology Program,” *Journal of Technology Transfer*, Summer 1998.

“Inside the Pin-Factory: Empirical Studies Augmented by Manager Interviews: Introduction” (with Severin Borenstein and Joseph Farrell), *Journal of Industrial Economics*, June 1998.

“Evidence from Patents and Patent Citations on the Impact of NASA and Other Federal Labs on Commercial Innovation” (with Bruce A. Banks and Michael S. Fogarty), *Journal of Industrial Economics*, June 1998.

Comment on “What Do Technology Shocks Do?” in Bernanke, Ben S., and Julio Rotemberg, eds., *NBER Macroeconomics Annual*, 1998.

“Universities as a Source of Commercial Technology: A Detailed Analysis of University Patenting, 1965-1988” (with Rebecca Henderson and M. Trajtenberg), *Review of Economics and Statistics*, February 1998; also published in a slightly different form as “University Patenting Amid Changing Incentives for Commercialization” in G.B. Navaretti, P. Dasgupta, K.-G. Maler and D. Siniscalco, eds., *Creation and Transfer of Knowledge*, Springer, 1998.

“Measurement Issues,” in L.M. Branscomb & J. Keller, eds., *Investing in Innovation*, MIT Press, 1998.

“University Versus Corporate Patents: A Window on the Basicness of Invention” (with M. Trajtenberg and R. Henderson), *Economics of Innovation and New Technology*, 1997.

“Environmental Regulation and Innovation: A Panel Data Study” (with K. Palmer), *Review of Economics and Statistics*, November 1997.

Review of *Green, Inc.*, by Frances Cairncross, *Journal of Economics Literature*, March 1997.

“Bounding the Effects of R&D: An Investigation Using Linked Establishment and Firm Data” (with J. Adams), *Rand Journal of Economics*, winter 1996

“Economic Analysis of Research Spillovers: Implications for the Advanced Technology Program,” Economic Assessment Office, The Advanced Technology Program, National Institutes of Standards and Technology, U.S. Department of Commerce, November 1996.

“Flows of Knowledge from Universities and Federal Labs: Modelling the Flow of Patent Citations over Time and across Institutional and Geographic Boundaries” (with M. Trajtenberg), *Proceedings of the National Academy of Sciences*, Vol. 93, pp. 12671-12677, November 1996.

“Trends and Patterns in U.S. Research and Development Expenditures,” *Proceedings of the National Academy of Sciences*, Vol. 93, pp. 12658-12663, November 1996.

“Should Electricity Markets Have A Capacity Requirement: If So, How Should It Be Priced?” (with F. Felder), *The Electricity Journal*, December 1996.

“Regional Localization of Technological Accumulation: Application to the Tri-State Region,” *The Annals of the New York Academy of Sciences*, 1996.

Comment on “Cross-Country Variations in National Economic Growth Rates” by J. Bradford Delong, in *Technology and Growth*, J.C. Fuhrer and J. Sneddon Little, eds., Federal Reserve Bank of Boston Conference Series No. 40, June 1996.

“Regulatory Reform and the Economics of Contract Confidentiality: The Example of Natural Gas Pipelines” (with J. P. Kalt, S. T. Jones, and F. A. Felder), *Regulation*, 1996, No 1.

“Planning for Change, Preparing for Growth: Implications for Massachusetts of Reductions in Federal Research Spending” (with Amy B. Candell, Kenneth W. Grant, Michael Laznik, and Kelly T. Northrop), The Economics Resource Group, Inc., funded by the Massachusetts Technology Collaborative, February 1996.

“Incentive Regulation for Natural Gas Pipelines” (with J. Kalt), in Ellig, J. and J. P. Kalt, eds., *New Horizons in Natural Gas Deregulation*, Praeger, 1996.

“The Emerging Coexistence of Competition and Regulation in Natural Gas Transportation” (with S. Makowka), *Hume Papers on Public Policy*, 1995.

“On the Microeconomics of R&D Spillovers” (with J. Adams), in Louis Lefebvre, ed., *Technology Management*, Paul Chapman Publishing, Ltd., 1995.

“An Economic Analysis of Electricity Industry Restructuring in New England” (with J. P. Kalt), The Economics Resource Group, Inc., funded by Northeast Utilities System Companies, April 1995.

“Dynamic Incentives of Environmental Regulations: The Effects of Alternative Policy Instruments on Technology Diffusion” (with R. Stavins), *Journal of Environmental Economics and Management*, 1995.

“Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?” (with S. Peterson, P. Portney and R. Stavins), *The Journal of Economic Literature*, 1995; reprinted in Alan M. Rugman and John J. Kirton, eds., *Trade and the Environment: Economic, Legal and Policy Perspectives*, Cheltenham, UK: Edward Elgar Publishing Limited, 1998.

Comment on “Taxes, Technology Transfer, and the R&D Activities of Multinational Firms” by James R. Hines, Jr., in Martin Feldstein, James R. Hines, Jr., and R. Glenn Hubbard, eds., *The Effects of Taxation on Multinational Corporations*, University of Chicago Press, 1995.

“The Energy-Efficiency Gap” (with R. Stavins), *Energy Policy*, 1994.

“The Investment Consequences of the Re-Regulation of Cable Television” (with W. Emmons and J. Taylor), The Economics Resource Group, Inc., Cambridge MA, 1994.

“Insight on Oversight” (with J. Kalt), *Public Utilities Fortnightly*, April 15, 1994.

“The Energy Paradox and the Diffusion of Conservation Technology” (with R. Stavins), *Resource and Energy Economics*, 1994.

“Energy-Efficiency Investments and Public Policy” (with R. Stavins), *The Energy Journal*, 1994.

“Prices, Regulation and Energy Conservation: An Econometric Analysis” (with R. Stavins), delivered at the Conference on Market Approaches to Environmental Regulation, Stanford University, December 1993.

Comment on “R&D and Market Value in the 1980s” by Bronwyn Hall, *Brookings Papers on Economic Activity, Microeconomics*, 1993.

“The Effect of Liquidity on Firms' R&D Spending” (with K. Hao), *Economics of Innovation and New Technology*, 1993.

“Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations” (with M. Trajtenberg and R. Henderson), *Quarterly Journal of Economics*, August 1993.

“Environmental Regulations and the Competitiveness of U.S. Industry” (with S. Peterson, P. Portney, and R. Stavins), U.S. Department of Commerce, Economics and Statistics Administration, Washington, DC, NTIS No. PB-93-193514, July 1993.

“Oversight of Regulated Utilities' Fuel Supply Contracts: Achieving Maximum Benefit from Competitive Natural Gas and Emission Allowance Markets” (with J. P. Kalt), The Economics Resource Group, funded by Enron Gas Services Corporation, April 1993.

“Achieving Maximum Benefit from Competitive Natural Gas and Emission Allowance Markets” (with J. Kalt), *Proceedings of the U.S. Department of Energy/National Association of Regulatory Utility Commissioners Conference on Natural Gas Use, State Regulation and Market Dynamics in the Post 636/Energy Policy Act Era*, March 1993.

“The Diffusion of Energy-Conserving Windows: The Effect of Economic Incentives and Building Codes” (with R. Stavins), presented at the American Economic Association annual meeting, Anaheim CA, January 1993.

“How High are the Giants' Shoulders: An Empirical Assessment of Knowledge Spillovers and Creative Destruction in a Model of Economic Growth” (with R. Caballero), in O. Blanchard and S. Fischer, eds., *National Bureau of Economic Research Macroeconomics Annual*, Vol. 8, MIT Press, 1993; reprinted in Gene M. Grossman, ed., *Economic Growth: Theory and Evidence*, Vol. II, Cheltenham, UK: Edward Elgar Publishing Limited, 1996.

Review of *Investing in the Future*, by John Irvine, et al., *Journal of Economic Literature*, June, 1992.

Review of *Productivity and U.S. Economic Growth* by D. Jorgenson, et al., *Business History Review*, 1991.

“Evaluating the Relative Effectiveness of Economic Incentives and Direct Regulation for Environmental Protection: Impacts on the Diffusion of Technology” (with R. Stavins), *CSIA Discussion Paper No. 91-1*, Center for Science and International Affairs, Environment and Natural Resources Program, John F. Kennedy School of Government, Harvard University, February 1991.

“Economic Evaluation of Policy Options for Global Climate Change: Some Methodological Reflections,” Center for Energy and Environmental Policy, John F. Kennedy School of Government, Harvard University, August 1990.

“Market Power of Local Cable Television Franchises: Evidence from the Effects of Deregulation” (with D. Kanter), *Rand Journal of Economics*, summer 1990.

“Unintended Impacts of Public Investments on Private Decisions: The Depletion of Forested Wetlands” (with R. Stavins), *American Economic Review*, June 1990.

“Universities and Regional Patterns of Commercial Innovation,” *REI Review*, Center For Regional Economic Issues, Case-Western Reserve University, 1989.

“Real Effects of Academic Research,” *American Economic Review*, December 1989; reprinted in Paula E. Stephan and David B. Audretsch, eds., *The Economics of Science and Innovation*, Cheltenham, UK: Edward Elgar Publishing Limited, 2000.

“Characterizing the ‘Technological Position’ of Firms, with Application to Quantifying Technological Opportunity and Research Spillovers,” *Research Policy*, 1987.

“Demand and Supply Influences in R&D Intensity and Productivity Growth,” *Review of Economics and Statistics*, August 1988.

“Technological Opportunity and Spillovers of R&D: Evidence from Firms' Patents, Profits and Market Value,” *American Economic Review*, December 1986; reprinted in Edward N. Wolff, ed., *The Economics of Productivity*, Cheltenham, UK: Edward Elgar Publishing Limited, 1997.

“Who Does R&D and Who Patents” (with J. Bound, *et al.*), in Z. Griliches, ed., *R&D, Patents and Productivity*, University of Chicago Press, 1984.

“Benefit-Cost Analysis and Multi-Objective Evaluation of Federal Water Projects,” *Harvard Environmental Law Review*, 1980.

“Preventing Groundwater Pollution: Towards a Coordinated Strategy to Protect Critical Recharge Zones (with J.T.B. Tripp), *Harvard Environmental Law Review*, 1979.

OTHER PROFESSIONAL ACTIVITIES

Member, Ministry of Business, Innovation and Employment Science Board, 2014 ongoing

Board Member, Asia-Pacific Innovation Conference, 2013 ongoing

Conference Co-Organizer, “The Changing Frontier: Rethinking Science and Innovation Policy,” National Bureau of Economic Research, August 2013

Editorial Board, Environmental Innovation and Societal Transitions, 2011 ongoing

Lead Author, Fifth Assessment Report, Intergovernmental Panel on Climate Change, 2011-2013

Invited Participant, NIH Science of Science Management meeting, October 2008

Consultant, Finance Ministry, Government of Chile, 2007

Keynote address, NSF Workshop on Advancing Measures of Innovation: Knowledge Flows, Business Metrics and Measurement Strategies, Arlington VA, 2006

Consultant, World Bank (evaluation of program in El Salvador to increase productivity in SME), 2006

Member, Board of Editors, Journal of Industrial Economics, 1995-2003; American Economic Review, 1995-2000; Associate Editor, Rand Journal of Economics, 1997-2003

Guest Associate Editor, Management Science Special Issue: "Managing Knowledge in Organizations," 2001

Lead Author, Third Assessment Report, Intergovernmental Panel on Climate Change, 1998-2001

Member, National Academy of Engineering Committee on the Impact of Academic Research on Industrial Performance, 1998-2001

Member, Economic Impact Committee, Association of University Technology Managers, 1994-95

Contributing Author, Working Group III (socioeconomics) of the Intergovernmental Panel on Climate Change (IPCC), 1994

Member, Stanford Energy Modeling Forum, Working Group on Energy Conservation (EMF 13), 1992-94

Referee/Reviewer for American Economic Review, Econometrica, Economic Inquiry, Economics of Innovation and New Technology, Journal of Economics Organization and Management, Journal of Environmental Economics and Management, Journal of Industrial Economics, Journal of Law and Economics, Journal of Political Economy, Quarterly Journal of Economics, Rand Journal of Economics, Research Policy, Review of Economics and Statistics, Science, and MIT Press.

TEACHING EXPERIENCE

Introductory Economics (undergraduate), Microeconomic Theory (Ph.D.), Law and Economics (undergraduate), Environmental and Natural Resource Economics (undergraduate), Industrial Organization (Ph.D. and undergraduate), Government Regulation and Antitrust Policy (Ph.D. and undergraduate), R&D, Innovation and Productivity Growth (undergraduate), Applied Welfare Economics (John F. Kennedy School of Government)

Foundation for American Communications, economics education for journalists, "The Role of Government in the Economy" (1996)

Designed and implemented a two-year Policy Analysis Lecture Series for the U.S. Army Corps of Engineers, New England Division, Regulatory Branch (1988-89)

HONORS AND AWARDS

Venice Award for Intellectual Property, Honorable Mention for Innovation and Its Discontents (2007)

Alfred P. Sloan Dissertation Fellowship, Harvard, 1984-85

Alfred P. Sloan Research Fellowship, MIT, 1976-77

Phi Beta Kappa, 1976

APPENDIX B: MATERIALS CONSIDERED**A. Public Documents**

- “As Smartphones Proliferate, Will One Company Emerge as the Clear Market Winner?”. Wharton (May 27, 2009).
- 17 U.S. Code § 504(b).
- Bresnahan, Timothy, and Shane Greenstein. “Mobile computing: The next platform rivalry.” *The American Economic Review* 104.5 (2014): 475-480.
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- Glick, Mark A., Lara A. Reymann, and Richard Hoffman. *Intellectual property damages: guidelines and analysis*. John Wiley & Sons, 2002.
- Hausman, Jerry A., Gregory K. Leonard, and Gregory Sidak. “Patent Damages and Real Options: How Judicial Characterization of Noninfringing Alternatives Reduces Incentives to Innovate.” *Berkeley Technology Law Journal* 22.2 (2007): 825-853.
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- *Oracle Corp. v. SAP AG*, 765 F.3d 1081 (9th Cir. 2014).
- *Polar Bear Productions, Inc. v. Timex Corp.*, 384 F.3d 700 (2004).
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- Taylor v. Meirick, 712 F. 2d 1112, 1120 7th Circuit 1983 (Posner, J.)
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- Zhu, Feng, and Marco Iansiti. “Entry into platform-based markets,” Strategic Management Journal 33.1 (2012).

B. Expert Reports

- Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.
- Expert Report of Professor Adam Jaffe, Feb. 8, 2016.
- Expert Rebuttal Report of Professor Adam Jaffe, Feb. 29, 2016.
- Expert Report of Professor James Kearl, March 18, 2016.

C. Court Documents

- Deposition of Professor James Kearl, March 23, 2016.

PROOF OF SERVICE BY KITEWORKS

I, José E. Valdés, am over the age of eighteen years old and not a party to the within-entitled action. My place of employment and business address is Orrick, Herrington & Sutcliffe LLP, 1000 Marsh Road, Menlo Park, California 94025.

On March 28, 2016, I served the following documents:

SUPPLEMENTAL EXPERT REPORT OF ADAM JAFFE, Ph.D.

on the interested parties in this action by electronic service [Fed. Rule Civ. Proc. 5(b)] by electronically mailing a true and correct copy, pursuant to the parties agreement, to the following email addresses:

DALVIK-KVN@kvn.com
JCooper@fbm.com
gglass@fbm.com

I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct.

Executed on March 28, 2016, at San Francisco, California.

/s/ José E. Valdés
José E. Valdés